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ORIGINAL ARTICLE

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# Venous anatomy of the right colon: three-dimensional topographic mapping of the gastrocolic trunk of Henle

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**Abstract Background** The gastrocolic trunk of Henle has not been described in detail in context with right hemicolectomy. The aim of this study was to define the caliber, length and three-dimensional position of the gastrocolic trunk of Henle (GTH). **Methods** We studied 10 fresh (<24 h) cadavers. A corrosion cast method was employed. Cold polymerized methylacrylate was injected into the superior mesenteric vein (SMV) and artery. GTH diameter, length and point of confluence with the SMV were assessed. **Results** The GTH was present in all specimens originating from the confluence of the right gastroepiploic and superior-anterior pancreaticoduodenal veins. The GTH joined the SMV at an average distance of 2.2 cm (range, 1.6–3.2 cm) from the inferior pancreatic border and it coursed towards the right side in a ventral-cranial direction. The mean caliber and length of the GTH were 5.2 mm (range, 4.8–5.8 mm) and 16.1 mm (range, 10.1–20.7 mm), respectively. **Conclusions** The GTH is a short, medium-sized vessel of potential clinical significance with a consistent ventral-cranial direction.

**Key words** Bleeding • Right hemicolectomy • Gastrocolic trunk • Henle • Three-dimensional mapping

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## Introduction

Accurate anatomical description of the superior mesenteric vein (SMV) and its tributaries at the inferior pancreatic border is important during oncologic resection of the right colon and transverse colon. Inadvertent traction at the root of the transverse mesocolon around the pancreas has been described as a cause of venous bleeding [1]. In the era of laparoscopic colonic surgery, precise knowledge of the anatomy is required, even more than before, to compensate for the lack of tactile feedback.

The gastrocolic trunk (GTH) was first described in 1868 by Henle as the confluence of the right superior colic and the right gastroepiploic (RGEV) veins draining into the SMV [2]. The GTH has been mentioned but not described in detail in context with right hemicolectomy [3]. Although the supplying vessels and its variations have been previously described [4–6], little has been reported in regards to the length, caliber and topography of the GTH.

## Materials and methods

Ten consecutive fresh (<24 h) adult cadavers (4 men) aged 25–85 years were obtained from the Institute for Forensic Medicine, Belgrade, Yugoslavia. The pylorus, duodenum, proximal jejunum with its mesentery, and spleen were extracted en bloc through a midline incision. The transverse mesocolon was carefully dissected off the bowel wall and preserved. The hepatoduodenal ligament was divided at its supraduodenal portion. The posterior surface of the pancreas was bluntly dissected, taking care not to damage the portal vein or any of its tributaries. Immediately after autopsy, the specimens were immersed in 0.9% saline solution at 37° C.

Corrosion casting was carried out in all 10 specimens. A 10 Fr polyethylene catheter was placed into the superior mesenteric vein (SMV) and artery (SMA), and irrigation with 0.9% saline solution was performed to wash out any retained thrombus. The branches

of the SMV and SMA were identified and ligated to prevent leakage of polymerized methylacrylate during injection. During injection of cold, polymerized methyl acrylate through the catheter, the specimens were immersed in water in order to regain their original shape. Following venous solidification, corrosion by accelerated saponification was then performed in a heated 35% potassium hydroxide solution. Any remnants of organic tissue were washed out in water and the casts were mounted on stands.

The approaching angles of the GTH to the superior mesenteric vein were reconstructed with the use of flexible copper wire and plotted on a three-dimensional (3D) Decart co-ordinate system.

A nonius scaleable ruler and a flexible copper wire were used to measure vessel length and internal diameter, respectively. Based on the methodology used, the external diameter (caliber) was estimated on the assumption of a 20% increase compared to the internal diameter.

## Results

The GTH was present in all 10 specimens and it originated from the confluence of the right gastroepiploic and anterior superior pancreaticoduodenal veins. The middle colic vein was an additional tributary on one occasion. The gastrocolic trunk terminated in the superior mesenteric vein at a mean distance of 2.2 cm (range, 1.6–3.2 cm) from the inferior border of the pancreas. The mean caliber of the GTH was 5.2 mm (range, 4.8–5.8 mm) and its mean length was 16.1 mm (range, 10.1–20.7 mm) (Fig. 1).

The GTH coursed on a ventral-cranial direction towards the right side of the patient (Fig. 2).

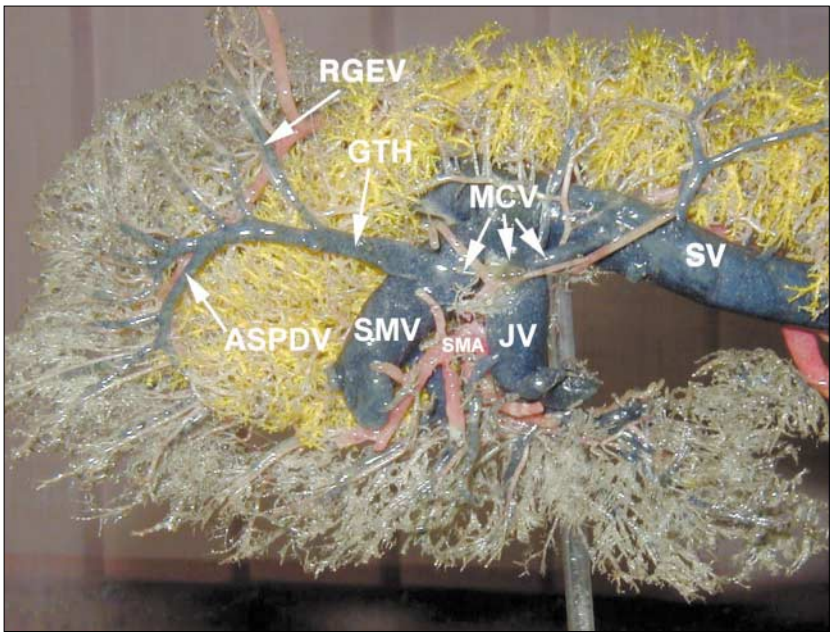


**Fig. 1** Demonstration of the gastrocolic trunk of Henle (GTH) with the corrosion cast method. *ASPDV*, anterior superior pancreaticoduodenal vein; *GTH*, gastrocolic trunk of Henle; *JV*, jejunal vein (prima); *MCV*, middle colic vein; *RGEV*, right gastroepiploic vein; *SMA*, superior mesenteric artery; *SMV*, superior mesenteric vein; *SV*, splenic vein

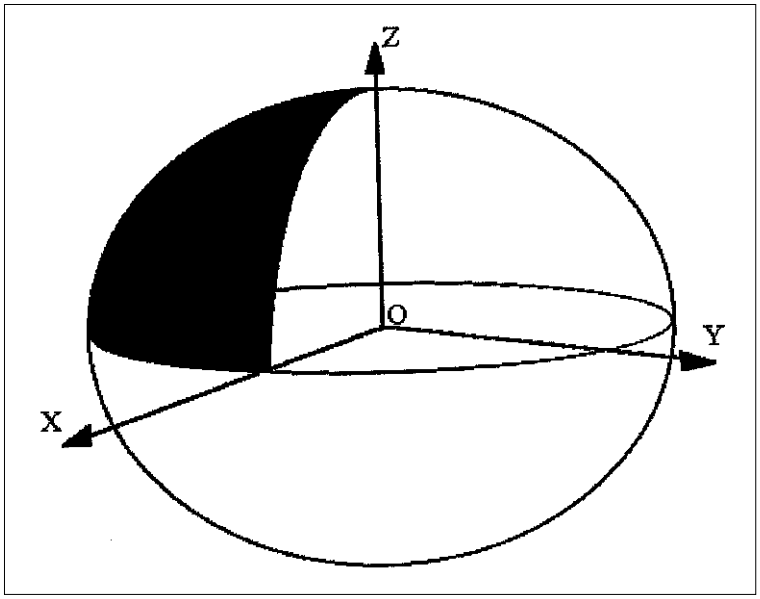


**Fig. 2** 3D reconstruction of the gastrocolic trunk of Henle (GTH). *Point O* is the center of the Decart system and it represents the confluence of the GTH and the superior mesenteric vein (SMV). The Y-axis represents the SMV. The direction of the SMV in the Decart system does not correlate with its anatomical direction into the human body. The *shaded area* represents the plane of GTH position. An imaginative line from each point of the shaded area to point O represents the possible directions of GTH in relation to SMV

## Discussion

The GTH is present in approximately 70% of the population and its anatomy can vary widely [4, 5]. The middle colic vein (MCV) and the right colic vein (RCV) occasionally form a common trunk with the right gastroepiploic vein (RGEV) and the anterior superior pancreaticoduodenal vein. This common trunk represents the GTH [5, 6].

An elegant study regarding the venous anatomy of the right colon in 58 cadavers by Yamaguchi et al. [4] showed that, depending on which colic vein joins the RGEV, the GTH may drain the transverse colon (74%) or the ascending colon (26%). When the GTH drains the transverse colon, a small accessory MCV is usually the tributary of the GTH, while the main MCV joins the GTH in only 12.1% of cases [5]. The GTH should be preserved when oncologic resection of the ascending colon is performed because on a few occasions its ligation may affect the venous drainage of the transverse colon. However, this is in contrast with the Japanese literature where a radical lymphadenectomy is advocated including the lymph nodes located anterior to the so-called surgical trunk (SMV between GTH and ileocolic vein) [6].

According to our results, the length of GTH is relatively short. Traction of the transverse mesocolon during right hemicolectomy can tear the GTH, leading to troublesome bleeding. Because of its short length, attempts to control bleeding from an injured or avulsed GTH can injure the superior mesenteric vein, which is a potentially devastating injury.

Preoperative visualization of the GTH on computed tomography (CT) [7, 8] may increase awareness and prevent accidental injury during surgery. Evaluation of the presence of GTH on CT prior to colonic or pancreatic surgery can be valuable, especially when portal hypertension is suspected. The evaluation of GTH was even more precise with thin-section 3D contrast-enhanced, dynamic, fat-suppressed magnetic resonance imaging (MRI) [9], where the GTH was identified in 92% of patients without portal hypertension, with a somewhat lesser caliber than our results show.

When venous bleeding from inadvertent traction of the transverse mesocolon is encountered during colonic surgery, the inferior border of the pancreas should be exposed. The surgeon should look for the source of bleeding approximately 1.5–2.0 cm caudal to the confluence of the SMV with the splenic vein. During this procedure, it is important to be aware of the ventral-cranial direction of the GTH towards the right side of the patient for the correct placement of a hemostatic clamp. Incorrect placement of the clamp can cause further injury to the SMV and enhance bleeding. Great care should be taken during suture ligation of the avulsed GTH to prevent narrowing of the SMV.

In conclusion, the GTH is relatively short in length and it has a consistent general direction. Precise knowledge of the anatomy of the GTH is important for surgeons performing colonic surgery.

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## Invited comment

The authors are to be congratulated for their time-consuming and arduous work in reconstructing the venous system of the right colon, particularly this gastrocolic trunk of Henle (GHT). Delineation of this vein, i.e. its origin, site, size and course, is useful in the fields of colorectal and pancreatic surgery, especially for surgeons performing laparoscopy-assisted resections of the right colon. The presence of the GTH in all 10 cadavers in this study suggests its common occurrence. The identification of this vein during surgery will greatly help in haemostatic control when there is injury and bleeding around the area. The authors meticu-

lously dissected this important structure using modern techniques and calculations, thus enabling them to precisely describe the anatomy. We have undertaken a similar exercise in our mortuary and have concurred with their views.

Although this is a useful and thought-provoking study, it is important to keep in mind the following shortcomings. First, the authors did not elaborate on the relationship between the right and middle colic veins and the gastrocolic trunk of Henle. As shown in a previous study of venous anatomy of the right colon, in which 58 cadavers were dissected [1], the GTH joined the right colic vein in 27.5% of cases and the middle colic vein in 75% (23% main middle colic vein, 77% accessory middle colic vein). In another study, the GTH was present in 69% of specimens [2], similar to the previously quoted incidence of its occurrence. A third study suggested that the presence of GTH may be as low as 46% [3]. As the number of cadavers in this particular study was small, its results are potentially different from a similar study done on a larger scale.

The authors mention traction injury, which would undoubtedly occur, but the major danger is failure of recognising the trunk and injuring it. Knowledge of GTH anatomy is also helpful in pancreatic surgery, especially during limited resections where it is possible to divide the gastroepiploic vein and anterior superior pancreaticoduodenal vein with preservation of the right superior colic vein and GTH [4].

The use of CT prior to colonic and pancreatic surgery in recognising the GTH (especially in patients with portal hypertension) would no doubt be beneficial as indicated by the authors. The results with MRI also seem promising, in particular, thin-section three-dimensional (3D) contrast-enhanced dynamic fat-suppressed imaging where more than 80% of the GTH can be seen [5].

In conclusion, this interesting and stimulating study has described yet another technical skill required of surgeons undertaking pancreatic and colonic surgery, particularly in laparoscopy-assisted cases.

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